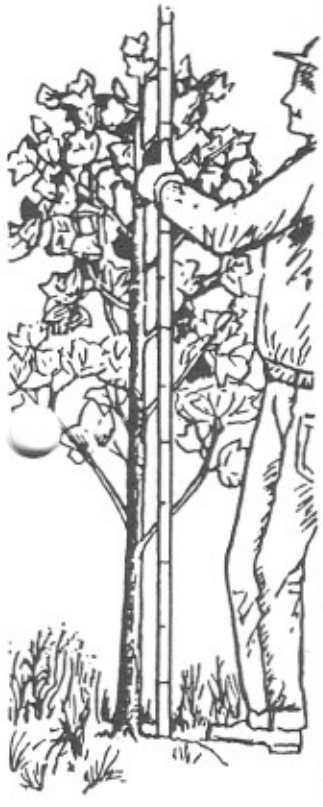

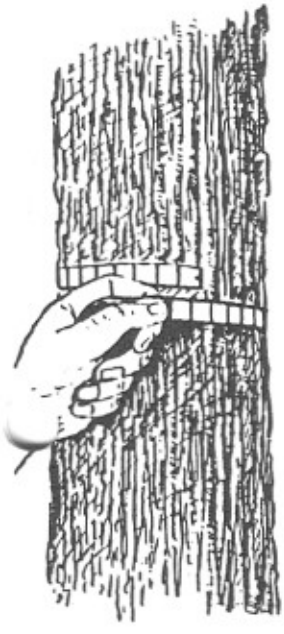

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PLANTING 1-0 WHITE PINE SEEDLINGS

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Abstract

Over a 3-year period, 86 rows of 1-0 white pine, 20 seedlings in a row, were planted on 13 different tracts. There were 7 rows of $^{2}/_{32}$-inch root collar diameter, 37 rows of $^{3}/_{32}$-inch, 33 rows of $^{4}/_{32}$-inch, and 9 rows of $^{5}/_{32}$-inch seedlings, reflecting the frequency of these diameter classes in the 1-0 seedbeds.

Smaller seedlings survived as well as larger seedlings. Average survival of $^{2}/_{32}$-, $^{3}/_{32}$-, $^{4}/_{32}$-, and $^{5}/_{32}$-inch seedlings was 71, 75, 70, and 64 percent after one season. On the other hand, height growth after planting increased with increasing initial root collar diameter.

When compared to 2-0 seedlings from three years of undercutting studies, that were planted on some of the same tracts as the 1-0 seedlings, 1-0 seedling survival at age 3 was 11.5 points higher than 2-0 seedlings that were not root pruned, but 6.6 points lower than 2-0 seedlings that had been root pruned. Height at age 3 averaged 1.8, 2.5, and 2.6 feet for 1-0, unpruned 2-0, and pruned 2-0 seedlings, respectively.

Introduction

In Virginia, we have always planted 2-0 white pine seedlings (seedlings that have grown for two seasons in the seedbed). If 1-year-old seedlings (1-0) could be planted successfully, it would reduce the cost of seedlings considerably and also reduce the acreage of seedbeds necessary to grow the white pine crop. One-year-old white pine seedlings are much smaller than 2-year-old seedlings, and most people would probably judge that their chances of surviving are poor. In the sandy soils of our New Kent and Sussex nurseries in eastern Virginia, 1-0 seedlings are usually taller and more uniform than 1-0 seedlings grown in the heavy-textured soils at our Augusta nursery in western Virginia. In the late winter of 1989, we decided to put in a small pilot test of 1-0 seedlings from our New Kent nursery, and the survival from 2 test plantings was encouraging. We installed additional studies in 1990 and 1991.

1989 STUDIES

On February 1, 1989, seedlings were hand-lifted from our New Kent nursery and

measured and separated by root collar diameter and top length. The seedlings too small to make the $^{2}/_{32}$-inch diameter class were discarded. We ended up with seedlings to plant in the $^{2}/_{32}$-, $^{3}/_{32}$-, and $^{4}/_{32}$-inch diameter classes. The overall average diameter was $^{3.4}/_{32}$. The top length of these seedlings ranged from 3 to 9 inches, and averaged 5.9 inches.

The seedlings were planted on the Appomattox Buckingham State Forest in the central Piedmont of Virginia and on private land in Botetourt County, in the Ridge and Valley province of Virginia. On the State Forest, 6 rows of 20 seedlings each were planted, 2 rows each of $^{2}/_{32}$-, $^{3}/_{32}$-, and $^{4}/_{32}$-inch seedlings. In Botetourt County, 8 rows of 20 seedlings each were planted, 4 rows each of $^{3}/_{32}$- and $^{4}/_{32}$-inch seedlings.

Seedlings were measured each year for 3 years. Survival at age 1, 2, and 3 and average height at age 3 is summarized in Tables 1 and 2.

Table 1. Average survival at age 1, 2, and 3 and average height (in feet) at age 3, Buckingham State Forest.

	Survival			Height
Initial Diameter	Age 1	Age 2	Age 3	Age 3
$^{2}/_{32}$	85.0	80.0	80.0	1.74
$^{3}/_{32}$	85.0	85.0	85.0	2.40
$^{4}/_{32}$	82.5	72.5	65.0	2.75

Table 2. Average survival at age 1, 2, and 3 and average height (in feet) at age 3, Botetourt County.

	Survival			Height
Initial Diameter	Age 1	Age 2	Age 3	Age 3
$^{3}/_{32}$	90.0	81.2	81.2	1.66
$^{4}/_{32}$	97.5	90.0	86.2	1.79

1990 Studies

Seedlings were lifted from our Sussex nursery by hand on 2 different dates, January 15 and March 21, 1990, and additional seedlings were lifted by machine in

February. Some of these seedlings were planted on the Appomattox Buckingham State Forest on March 23. Seedlings hand lifted on January 15 and March 21 were planted in 4 randomized blocks including 3 different seedling diameter classes: $^{3}/_{32}$-, $^{4}/_{32}$-, and $^{5}/_{32}$-inch. The seedlings machine lifted in February were planted in 2 randomized blocks including 3 diameter classes: $^{2}/_{32}$-, $^{3}/_{32}$-, and $^{4}/_{32}$-inch.

Additional seedlings from each of the 3 liftings were planted on private land at scattered locations in the Piedmont and Mountains. The plantings on private land involved from 3 to five 20-seedling rows on each tract, each row of a different diameter class or lifting date.

The studies installed on the State Forest were measured each year for 3 years (Table 3 and 4).

Table 3. Average survival at age 1, 2, and 3 and average height (in feet) at age 3, for January 15 and March 21 hand liftings.

		Survival			Height
Lift Date	Initial Diameter	Age 1	Age 2	Age 3	Age 3
January 15	$^{3}/_{32}$	60.0	53.8	53.8	1.29
	$^{4}/_{32}$	57.5	53.8	52.5	1.44
March 21	$^{3}/_{32}$	68.8	57.5	55.0	1.15
	$^{4}/_{32}$	68.8	61.2	57.5	1.37
	$^{5}/_{32}$	73.0	68.8	66.2	1.48

Table 4. Average survival at age 1, 2, and 3 and average height (in feet) at age 3 for February machine lifting.

	Survival			Height
Initial Diameter	Age 1	Age 2	Age 3	Age 3
$^{2}/_{32}$	80.0	77.5	77.5	1.28
$^{3}/_{32}$	85.0	77.5	72.5	1.48
$^{4}/_{32}$	67.5	52.5	52.5	1.46

The replicated studies planted on the State Forest were carefully maintained and hardwood sprouts were cut back to reduce competition for the planted pine seedlings. This was not true of the plantings on private landholdings, so survival after one season in the field is presented (Table 5).

Table 5. Survival after one season for individual 20-seedling rows by county, lifting date, and initial diameter.

	Hand Lifted January 15				Machine Lifted February			Hand Lifted March 21		
County	2	3	4	5	2	3	4	3	4	5
Albemarle	30	45	30	37	--	--	--	--	55	--
Amherst	--	--	--	--	--	95[1]	--	--	90	--
Nelson	85	90	65	--	--	80	85	--	--	--
Botetourt	--	60	45	--	--	30	--	--	--	--
Franklin	--	75	65	--	--	85	--	--	--	--
Carroll	--	75	75	--	--	95	--	--	--	--
Wythe	--	70	50	--	--	100	--	--	--	--
Augusta	53	65	95	60	--	--	--	--	75	--

1991 Studies

Seedlings were machine-lifted during the week of March 4, 1991 from our New Kent nursery and measured and separated by root collar diameter on March 11. On March 25, we planted 9 rows of 20 seedlings each on the Buckingham State Forest, 3 rows each of $^{3}/_{32}$, $^{4}/_{32}$, and $^{5}/_{32}$. There were not enough $^{2}/_{32}$-inch seedlings for a 20-seedling row. On March 18, 6 rows of 20 seedlings each, 3 rows each of $^{3}/_{32}$ and $^{4}/_{32}$, were planted on a privately owned tract in Amherst County.

On the State Forest, survival after 1, 2, and 3 years, and average height after 3 years is summarized in Table 6.

[1] Mean of 3 rows.

Table 6. Average survival at ages 1, 2, and 3, and average height (in feet) at age 3.

	Survival			Height
Initial Diameter	Age 1	Age 2	Age 3	Age 3
$^{3}/_{32}$	58.3	48.3	48.3	1.57
$^{4}/_{32}$	50.0	48.3	45.0	1.78
$^{5}/_{32}$	61.7	46.7	46.7	2.02

On the privately-owned tract, the seedlings were measured just once, at age 3 (Table 7).

Table 7. Average survival and height at age 3.

Initial Diameter	Survival	Height
$^{3}/_{32}$	73.3	1.53
$^{4}/_{32}$	78.3	2.12

Comparison with 2-0 Seedlings

We can make a reasonably good comparison of 1-0 and 2-0 seedling survival because we had undercutting studies in 2-0 seedlings during these same years at the same nurseries.[2] Also, the 1-0 and 2-0 seedling studies were planted on the same tracts on the Buckingham State Forest in 1989, 1990, and 1991, and on the same tract in Botetourt County in 1989 (Table 8). Mortality after the first season was greater for 1-0 than 2-0 seedlings, an average of 9.5 points for 1-0 and 4.4 for 2-0 during the second and third seasons in the field (Table 8). Consequently, the best comparison is after three seasons, when 1-0 survival averaged 11.5 points higher than 2-0 seedlings that had not been root pruned and 6.6 points lower than 2-0 seedlings that had been root pruned.

[2]See Occasional Report #116, Root Pruning White Pine Seedlings in the Seedbed.

Table 8. Comparison of 1-0 and 2-0 survival after first and third seasons and height (in feet) after three seasons.

		Percent Survival						Height		
		First Year			Third Year			Third Year		
			2-0			2-0			2-0	
Year Planted	Tract	1-0	Control	Root Pruned	1-0	Control	Root Pruned	1-0	Control	Root Pruned
1989	Buckingham SF	84.2	51.9	70.6	76.7	46.2	66.2	2.30	2.64	3.02
	Botetourt Co.	93.8	76.0	92.1	83.8	69.4	89.5	1.72	1.91	2.02
1990	Buckingham SF	69.6	60.0	81.0	59.4	58.1	77.7	1.35	2.71	2.86
1991	Buckingham SF	56.7	50.8	66.0	46.7	46.6	59.4	1.79	2.60	2.42
Means		**76.1**	**59.7**	**77.4**	**66.6**	**55.1**	**73.2**	**1.79**	**2.46**	**2.58**

The height of 1-0 seedlings is still substantially less than 2-0 seedlings at age 3 (Table 8).

Discussion

These studies suggest that planting 1-0 seedlings operationally might be worth considering. There would be several advantages to planting 1-0 seedlings in addition to the cost savings:

1) Root systems are smaller and easier to plant with the roots properly placed in the planting slit. 2-0 seedlings are difficult to plant properly.

2) They are much less bulky, and far more seedlings can be carried in a planting bag.

3) A better planting job can be done on rocky and shallow soils, because planting holes don't have to be as deep.

A disadvantage is that it would be easy to completely bury the smaller seedlings. Excluding $^{2}/_{32}$-inch seedlings would eliminate much of this problem.

The slower height growth would be a problem on many tracts, and a better job of competition control, both woody and herbaceous, might be necessary with 1-0 seedlings.